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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/808,267

03/11/2004

Jonathan Schuler

NC 84,655

4786

26384

7590

07/26/2005

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EXAMINER

EDWARDS, PATRICK L

ART UNIT

PAPER NUMBER

2621

DATE MAILED: 07/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/808,267	Applicant(s) SCHULER ET AL.	
	Examiner Patrick L. Edwards	Art Unit 2621	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 December 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7 and 8 is/are rejected.
- 7) ☒ Claim(s) 6 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10 December 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>12-10-2004</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION***Drawings***

1. Figure 7 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

2. Figure 2 contains the word "TARID." It does not appear that this word is used in the disclosure, and it is not clear what this word means.

Further, Figure 2 contains two instances of the identifier "210".

Information Disclosure Statement

3. The prior art system described in the background of the applicant's disclosure is considered extremely pertinent to the prosecution of the application. Applicant has cited several references but has failed to provide them in an IDS. The examiner hereby requests that the applicant provide an information disclosure statement with these documents. The documents are listed in the specification as follows:

- Chapter 8 of Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall 1989
- W.F. O'Neal "Experimental Performance of a Dither-Scanned InSb Array" Proceedings on the 1993 meeting of the IRIS Specialty Group on Passive Sensors.
- T.S. Huang, "Multiple frame image restoration and registration" Advances in computer vision and image processing, vol. 1, JAI Press, 1984.
- Digital Video Processing, A.M. Tekalp, 1995 Prentice Hall, pp 81-86
- 1972, J. Opt. Soc. Am., 62, 55 (Lucy-Richardson blind deconvolution)
- 1996, Astronomy and Astrophysics, 17, 5 ("pixon-based deconvolution")

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 3 and 4 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 3, the term "said template" lacks antecedent basis.

Regarding claim 4, the metes and bounds of the of the claim are not clear as currently recited. It is unclear what the five terms in the body of the claim are modifying. Are they a list of "pixel quantities"?

Art Unit: 2621

Further, the language of the preamble is awkward and confusing. The examiner is unable to make sense out of claim as it is currently written. For instance, is something being associated with each pixel quantity? Or are "quantities relevant to subsequent image restoration" being associated with each pixel? Or is something being associated with "each" ("each" being a video sequence)? As currently written, it is impossible to tell.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

7. Claims 1, 2, 4, 5, and 8 are rejected under 35 U.S.C. 102(a) as being anticipated by Rumo et al. ("Superresolution in Images Using Optical Flow and Irregular Sampling")

Regarding claim 1, Rumo discloses collecting a video sequence of images from an object source (Rumo abstract: "images sequence").

Rumo further discloses estimating motion associated with said video sequence of images (Rumo pg. 1: "integer pixel shift estimator." The estimate of a shift between images is motion estimation.).

Rumo further discloses assembling said video sequence of images to form a single composite image based on estimate positions of individual pixels (Rumo abstract: "from these shifted low resolution images ... a higher resolution aliasing-free image can be constructed")

Rumo further discloses restoring a composite image (Rumo abstract: "the reconstructed image").

Regarding claim 8, which merely claims a system comprising a computer executing software to perform the method of claim 1, such a system is inherent in the Rumo disclosure because the inputting of images, the computations involving those images, and the subsequent display of enhanced images inherently require a computer executing software in order to be performed.

As applied to claim 2, Rumo discloses selecting a single image frame from said video sequence as a template from which motion of all other frames of video is estimated (Rumo pg. 1: "we compute the estimate shift for all images one-by-one with a single, arbitrary chosen, reference image." The reference image described in Rumo is analogous to the claimed template image.).

As applied to claim 4, Rumo discloses associating pixels of the sequence with the following quantities:

- (1) pixel intensity (pixels inherently have an intensity associated with them);
- (2) x-coordinate location (this is also inherent in a computer image processing method and system);
- (3) y-coordinate location (again, this is inherent);

Art Unit: 2621

(4) x-coordinate location estimate uncertainty (Rumo pg. 4: "each point is associated with a weight of likelihood." This weight of likelihood from Rumo is analogous to the estimate uncertainty from the claim. Further, "each point" from Rumo has an x-coordinate location and a y-coordinate location.);

(5) y-coordinate location estimate uncertainty (see #4 above).

As applied to claim 5, Rumo discloses defining and constructing a lattice array with a higher sampling density than a template image (Rumo fig. 2: The reference describes constructing a lattice array (as shown in fig. 2b) which has a greater sampling density than the template image (such as in fig. 2a)).

Rumo further discloses computing for each lattice site an associated coordinate interval corresponding to a rectangular span of each lattice site relative to said template image coordinate grid (Rumo fig. 2: The associated coordinate interval (as shown in fig. 2b) corresponds to the template image (as shown in fig. 2a). Fig. 2b has lattice sites which correspond to the template image (i.e. the squares defined by the bolder lines)).

Rumo further discloses finding and selecting all pixels whose estimated coordinates and uncertainty intervals are statistically likely to belong within the rectangular span of each lattice site (Rumo fig. 2 in conjunction with pg. 4: "weight of likelihood").

Rumo further discloses processing intensity values associated with selected pixel by an aggregate estimator to produce a single intensity estimate for each lattice site thus forming a composite image (Rumo pg. 4, sec. 3.5: The reference describes a least squares plane fitting algorithm which qualifies as the claimed "aggregate estimator" since it produces a single intensity estimate (i.e. "new sample value")).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 3 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rumo as applied to claim 1 above, and further in view of applicant's admitted prior art. The arguments as to the relevance of Rumo as applied above are incorporated herein.

As applied to claim 3, Rumo further discloses the step of estimating motion associated with said video sequence assumes a displacement (Rumo pg. 1: again, the shift between images is a displacement. Rumo assumes that such a displacement exists).

Rumo further discloses estimating nearest pixels displacement by image correlation (Rumo pg. 1: The reference describes that the integer pixel shift estimator is based on crosscorrelation).

Rumo further discloses tagging every pixel in said template with a whole integer coordinate (Rumo fig. 2: The images of fig. 2a can be seen to be broken up into a coordinate. Inherently, each one of these pixels is defined by a

Art Unit: 2621

spatial location (i.e. "tagged"). We know that the interval coordinates are whole integers because of sec. 4.2 which describes that the size of the original image was 300 x 200.).

Rumo further discloses tagging every pixel in other frames with an adjusted coordinate based on the displacement of said other frames (Rumo fig. 2: The reference shows that the pixels of other frames are "tagged" (i.e. defined by a spatial location) based on the displacement with respect to the template image.

Rumo discloses estimating subpixel displacement, but fails to expressly disclose estimating subpixel displacement by a least squares solution of brightness constancy constraint equations applied to aligned images. Applicant's admitted prior art, on the other hand, discloses "implement[ing] sub-pixel image displacement by numerical solution to the Brightness Constancy Constraint" (see pg. 8 of applicant's spec.). It would have been obvious to one reasonably skilled in the art at the time of the invention to modify Rumo by using the well known and robust algorithm taught by applicant's admitted prior art. Such a modification would have allowed for a numerical solution to the problem of subpixel displacement.

As applied to claim 7, Rumo discloses the restoration of a composite image, but fails to expressly disclose an image deconvolution, restoration with enhancement algorithm. Applicant's admitted prior art, on the other hand, discloses a deconvolution as a single frame enhancement (restoration) algorithm (see applicant's specification pg. 16). It would have been obvious to one reasonably skilled in the art at the time of the invention to modify Rumo by adding the image enhancement algorithm from the admitted prior art. Such a modification would have allowed for an acuity enhanced image (applicant's spec. pg. 16).

Allowable Subject Matter

10. Claim 6 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.
- Irani et al., 'Super Resolution From Image Sequences', Department of Computer Science, Hebrew University of Jerusalem, IEEE 1990.
 - Irani et al., 'Motion Analysis for Image Enhancement: Resolution, Occlusion, and Transparency '
 - Peleg et al. (USPN 6,434,280) discloses the generation of a super-resolution image from several image frames.
 - Sun (US 2004/0165781) discloses motion estimation/optical flow techniques
 - Olsson (USPN 6,445,415) discloses using multiple images to gain increased depth of field.

Art Unit: 2621

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patrick L. Edwards whose telephone number is (571) 272-7390. The examiner can normally be reached on 8:30am - 5:00pm M-F.

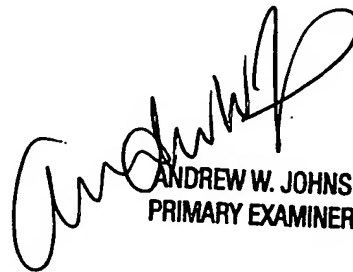
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joe Mancuso can be reached on (571) 272-7695. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Patrick L. Edwards

Art Unit 2621

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ANDREW W. JOHNS
PRIMARY EXAMINER